

On *Heterolepidotus grandis*, a Fossil Fish from the Lias.

By JAMES W. DAVIS, F.L.S., F.G.S.

[Read 6th November, 1884.]

(PLATE VII.)

GENUS HETEROLEPIDOTUS, *Egerton*.

Head large; snout obtusely conical; maxillary and mandibular bones straight; teeth of various sizes, the larger ones strong and bluntly pointed, the smaller ones sharp and numerous; gape wide; pectoral and ventral fins large; dorsal fins remote; scales large, thick, and lustrous, more or less serrated on the posterior margins; abdominal scales small and elongated; tail broad, the upper lobe ridged, with strong fulcral scales. (*Egerton*.)

HETEROLEPIDOTUS GRANDIS, sp. nov.

The fossil fish which serves as subject for the following description is a remarkable specimen, measuring 40 inches in length. Its bony structure is preserved and well exposed, whilst the scales, which are apparently thin, are preserved only in patches, principally on the anterior dorsal and ventral surfaces of the fish. The head is not well preserved; its component bones are disturbed and dissociated. A mass of iron pyrites envelopes the bones of the vertebral column from its connexion with the head backwards as far as the anal fins, beyond which the vertebræ are well defined.

The particulars following give the size and relative proportions of the fish:—

Length.....	40 inches.
Depth behind the pectoral fin .....	8 "
Depth between the dorsal and ventral fins. . . . .	6 "
Depth at the base of the tail.....	3·5 "
Diameter between the extremities of the lobes of the tail .....	10·5 "
Length of the head.....	8 "
Occiput to dorsal fin .....	11 "
Base of dorsal fin .....	5 "
Dorsal fin to base of caudal .....	10 "
Anterior of pectoral fin to ventral .....	12 "
Anterior of ventral fin to anal .....	6 "
Anterior of anal to base of caudal fin ....	7 "

A comparison of these measurements with those given by Sir Philip Egerton (Memoirs of the Geological Survey, decade xiii. plate 3), in the description of *Heterolepidotus latus*, shows that

the latter was a fish considerably deeper in proportion to its length than the present one; and whilst the form of this specimen was slim and graceful, its fins are longer, more powerfully developed for rapid motion than those of *H. sauroides*, Egert. (*op. cit.* pl. 2). The scales on the dorsal and median surfaces, represented natural size on my Plate VII. fig. 2, are rhomboidal in outline: those on the ventral surface are larger and elongated, gradually becoming still longer as they near the ventral line, where the scales are twice as long as broad. The scales are thin and apparently flexible, which may account for their not being very extensively preserved. They are covered with small pustulations on a thin coating of ganoine. Thus, whilst the scales are similar in form and possess the distinguishing characteristics of the *Heterolepidoti*, as defined by Sir P. Egerton, they differ in being very thin and pustulate. The exposed bones of the cranium are also covered with rugose pustulations on the surface of the ganoine. In some instances the pustules attain  $\cdot 1$  inch in diameter. The remaining bones of the head are more or less smooth or striated. The lower jaws are 5 inches in length, and a number of teeth are scattered about, some of them in small patches, indicating that they were closely aggregated on the surface of the jaws. The teeth are small, about  $\cdot 1$  inch in length, conical and pointed. If the fish had a series of larger teeth, they have entirely disappeared. The external cranial plates are preserved, and the scapulo-coracoid arch supporting the large pectoral fins is strong and powerfully built.

The anterior portion of the vertebral column is unfortunately enveloped in iron pyrites; the posterior part, behind the anal fin to the base of the caudal, consists of about 20 vertebræ; the termination of the column, composed of an additional 9 vertebræ, is deflected so as to enter the upper lobe of the tail, the latter having a decidedly heterocercal form. The lower lobe consists of 16 rays, which are attached to the under surface of the vertebræ by a number of broad, somewhat spatulate and flattened, hæmal spines, expanding so as to form a rounded termination for articulation with a second series of intermediate bones, to which the fin-rays are attached. The latter consist of a series of jointed ossicles; the longest rays are 6·5 inches in length, and repeatedly dichotomize. The lower margin of the tail is furnished with a long series of imbricating fulcral rays. Surrounding, and attached to the caudal vertebræ, of which nine

ascend almost at right angles into the upper lobe of the tail, there are ossicles intermediate between the vertebræ and the fin-rays. They are smaller in size than those of the lower lobe, and extend not only from the ventral but also from the dorsal surface of the vertebræ. The outer fin-rays, springing from the extremity of the vertebral column, are the strongest and attain a length of over 6 inches; about 1·5 inch at the base is solid, the remaining portion being composed of articulations, jointed at very short intervals and divided repeatedly into divaricating branches. The dorsal margin of the fin is strengthened by a series of fulcral rays, much larger and stronger than those of the lower lobe. They spring from the series of ossicles attached to the neural surface of the vertebræ already mentioned, and form a strong support to the long fin-rays extending from the termination of the bony axis of the body. The fulcral ray forming the base of the series is 1·3 inch in length; that portion of it imbedded in the integuments of the fish is divided into five prong-like rootlets, the outermost nearly half an inch apart. The succeeding fulcra are longer and narrower; and beyond these they gradually decrease in size. The whole fin possesses characteristics indicating great power combined with the utmost pliability.

The dorsal and anal fins are supported by strong neural and hæmal spines attached to the vertebræ. Between these and the fin-rays are, respectively, the interneural and interhæmal spines. The interspinous bones supporting the dorsal fin are about 1·5 inch in length, pointed at the lower extremity, the upper one enlarged and rounded, with a cup-like extremity, to form an articulated base of attachment for the fin-rays. The latter are round at the base, fitting to the interspinous bones; the ray for a length of 1·5 inch is undivided; it has a somewhat sigmoidal curvature, and is about ·15 inch in diameter. Between the principal rays are others of the same length but much thinner. Springing from the posterior surface of the base of one ray, they approach, and appear to have been attached to, the upper anterior extremity of the next. The upper extremity of the major fin-rays is enlarged and immediately bifurcates, the bifurcations redividing as in the caudal fin. The subdivisions of the fin-rays are jointed in a similar manner to those of the caudal fin. The dorsal fin is composed of 18 fin-rays besides the smaller intermediate ones, and when perfect would be fully 6 inches in greatest altitude. The anterior margin is strengthened by a series of imbricating

fulcral spines. The anal fin is not well preserved, but sufficient remains to indicate that it was a strongly built and powerful fin.

The ventral fin is situated opposite to the dorsal. It was supported by a large pubic bone, a part of which is preserved attached to the base of the fin. The exact number of rays is not clearly defined. They are strongest on the outer or anterior portion of the fin, and gradually assume smaller proportions backwards. The anterior ray was probably 4.5 inches in length; nearly half the length is unjointed; beyond, it is divided by numerous articulations and becomes rapidly divided into numerous filamentous branches. The anterior margin of the fin is strengthened by numerous imbricating fulcral rays, averaging .5 inch in length, and extending 3 inches from the base; they are round in section, and being considerably less in diameter than the fin-ray they cluster round it, grouped in a more or less semicircular manner.

The pectoral fin is composed of 24 rays. The anterior ones are 8 inches in length, remarkably strong, and attached by a peculiar articulation to the shoulder-girdle. The anterior rays of this fin are represented, natural size, by the drawing on Plate VII. fig. 3; and a reference to the figure will explain, better than words, the form of the joint. The three anterior rays are attached by a kind of ball-and-socket joint to a projection of the scapular portion of the shoulder-girdle, a second portion of which, or bones in connexion with it, which may be the equivalents of the carpal bones of the bony fishes, descends towards the posterior portion of the fin and supports the remaining fin-rays. The fin-rays are simple and undivided to one third their length from the base, beyond which they are articulated and dichotomize repeatedly. A number of small imbricated rays are attached to the anterior fin-rays; compared, however, with those of the other fins they are small and inconspicuous.

The genus *Heterolepidotus* was instituted by Sir Philip Egerton for the reception of fishes in many respects closely related to *Lepidotus*, Ag., but differing from that genus in their dentition, and more especially in the form and arrangement of the scales of the body. In *Lepidotus* the scales are uniform in size over the whole surface of the body; but in *Heterolepidotus* the scales on the ventral and abdominal surfaces of the body are greatly elongated and much resemble the long and narrow scales

of *Eugnathus* on the same region of its body. The teeth of *Lepidotus* are of two kinds—obtusely pointed and uniform in size in the jaws, or rounded and palatal like those of the Pycnodonts; in the genus now considered the teeth are numerous, pointed, and may vary in size. The specimen described above agrees with Egerton's definition of the genus *Heterolepidotus* in possessing elongated scales on the ventral region of the body and in having sharply pointed teeth, but in this specimen the teeth appear to have been uniform in size, and in this respect it differs from either of the two species described in the 13th decade of the Memoirs of the Geological Survey. The scales also, whilst conforming to the generic requirements, are thin and pustulate and devoid of serrations on their posterior margin, whereas in those already described the scales are thickly coated with ganoine and have the margins serrated. In form this example is more nearly related to the slim *H. savroides* from Barrow-on-Soar than to the thick-bodied *H. latus* of Lyme Regis. The bony skeleton of the specimen now described is more satisfactorily exhibited than has perhaps previously happened, and it exposes some points of considerable interest; amongst others, the attachment of the dorsal and anal fins, with the series of well-developed interspinous bones, the peculiar arrangement of the articular apparatus of the pectoral fins, and the heterocercal form of the tail. Sir P. Egerton considered that the caudal fin of the *Heterolepidoti* was of strictly homocercal form; but it is evident from this specimen that the fin-rays are wholly supported from the hæmal surface of the spine, and that only the fulcral plates are supported from the neural—an arrangement which is the same as that in the living *Lepidosteus*, though the form of the tail in the latter is externally diphyrcercal, whilst that now described is deeply forked.

Whilst it is evident that in many particulars the specimen now described does not clearly coincide with the characters of the genus *Heterolepidotus* as defined by Egerton, it is nevertheless undesirable to multiply genera, and it is proposed to include this species in the genus *Heterolepidotus*, with the specific appellation of *grandis*.

The figure of the specimen has been reduced to one third the size of the original by Mr. Henry Sykes, to whom I am much indebted for the careful and admirable manner in which the drawing has been rendered.

*Formation and Locality.* Lias: Lyme Regis.

## DESCRIPTION OF PLATE VII.

Fig. 1. *Heterolepidotus grandis*, Davis, one third nat. size.

Fig. 2. Scales, natural size.

Fig. 3. Anterior fin-ray of the pectoral fin, natural size.

On some Points in the Development of *Motella mustela*, L.

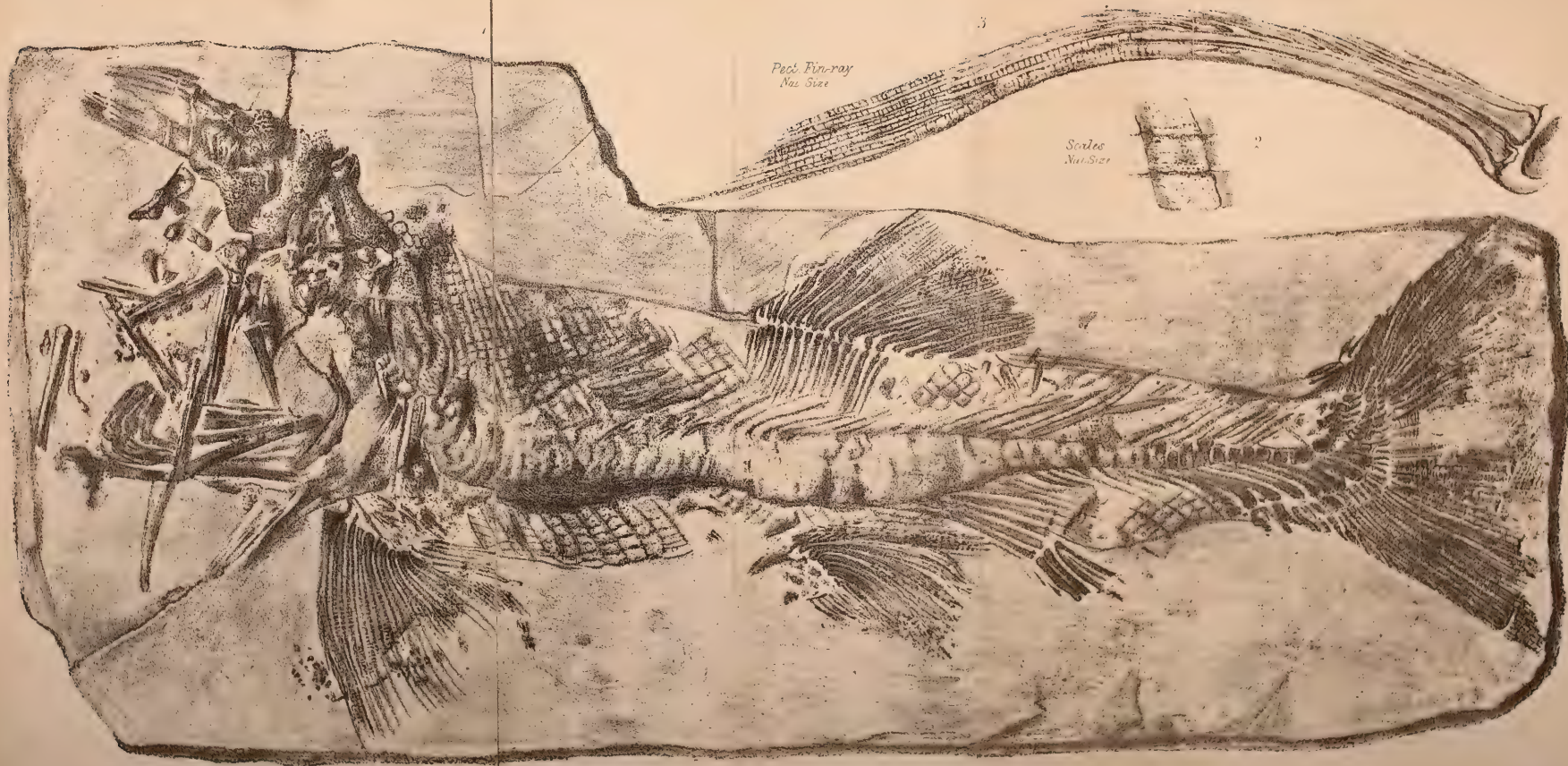
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(PLATES VIII.—X.)

THE eggs of *M. mustela* which I have been enabled to study were deposited in my aquarium during the months of May and June. They belong to the pelagic group of Teleostean eggs, and have usually one large oil-globule which keeps them floating on the surface of the water, although in a few cases I have found a cluster of from two to eight, or even more. These, however, were abnormal forms. Dr. Day, in his 'Fishes of Great Britain and Ireland,' i. p. 315, quotes from the 'Zoologist,' 1879, p. 476, the following words of Cornish:—"The nest wherein the spawn is deposited is invariably formed of the Common Coralline, *Corallina officinalis*, thrust into some cavity or crevice of a rock close to low-water mark." There must surely be some error in this observation, as it is manifestly entirely contrary to the nature of a pelagic egg to be retained in a nest. The eggs of all the other Gadidæ, so far as known, are pelagic, so that there is nothing exceptional in those of *Motella* being so.

The eggs are somewhat oval in shape, and are not all of equal size. The length of the longer axis varies from .655 millim. to .731 millim., and that of the shorter axis from .640 millim. to .716 millim. The shape, however, seems to vary considerably. Many are almost globular; and the oval shape seems often to be produced by three or four eggs touching one another. The slightest pressure alters the shape of the egg in this species, a feature which I have never observed in the egg of *Trachinus*. In normal eggs the single oil-globule is usually about .11 millim. in diameter. In those eggs with more than one oil-globule there is usually about the same volume of oil as in the large single globule, but divided into larger or smaller globules, according to the number. A batch of eggs which were laid on the 28th of May had the majority of the eggs with more than one oil-globule,



Pect. Fin-ray  
Nat. Size

Scutes  
Nat. Size